# Technical Advisory Committee

## Elizabeth River PCB TMDL

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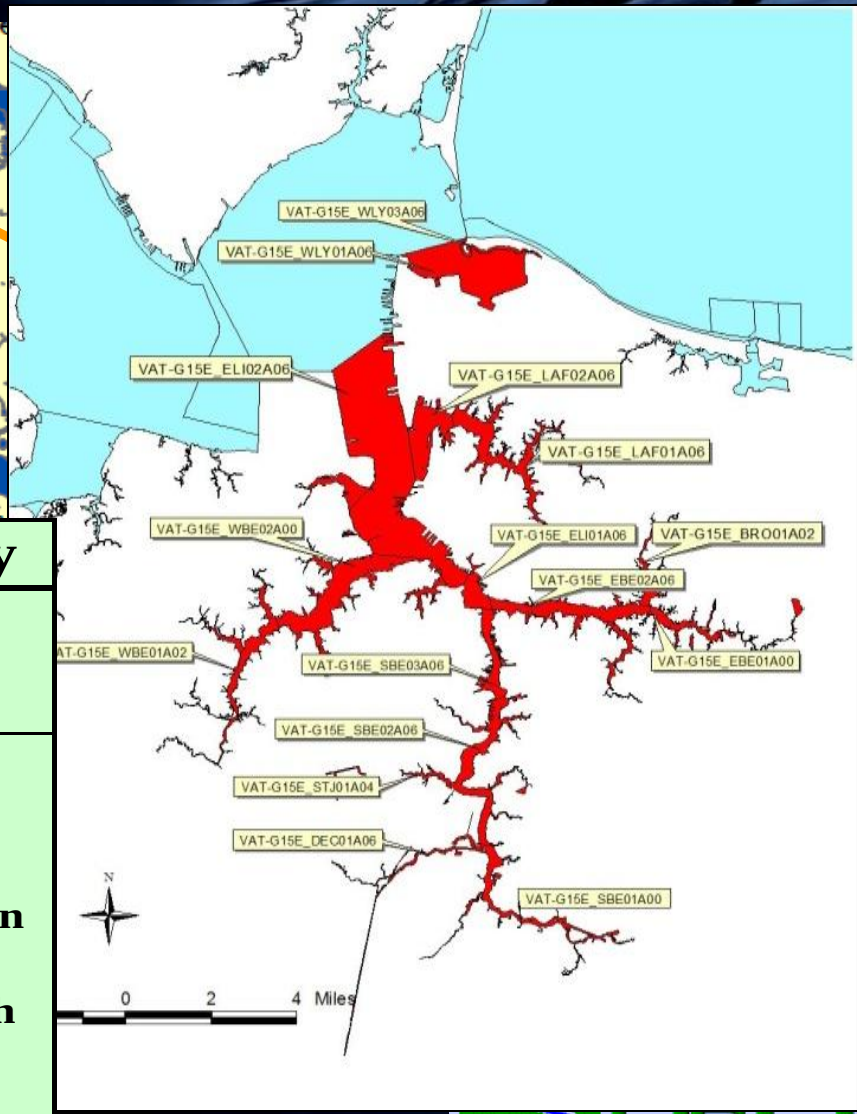
# Purpose of TAC

- Provides an opportunity for DEQ & VIMS to:
  - Inform interested stakeholders on TMDL progress
  - Address comments (VSRA)
- TAC Role
  - Assist in solving technically challenging problems
  - Address specific topics i.e., form Work Groups if necessary
    - MS4, other (?)

# Tidal James River PCB Impairment


| Fish Species | Advisory |
|---|---|
| **Gizzard Shad,** Carp, Blue Catfish & Flathead Catfish ≥ 32 inches | **Do Not Eat** |
| Blue Catfish & Flathead Catfish < 32 inches, Channel Catfish, White Catfish, Largemouth Bass, Bluegill Sunfish, **American Eel**, Quilback Carpsucker, Smallmouth Bass, Creek Chub, Yellow Bullhead Catfish, **White Perch**, **Blueback Herring**, **Striped Bass**, Hickory Shad, **Croaker, Spot, Bluefish** | **No more than two meals/month** |

# PCBs – A Legacy or On-going Issue?

- PCBs used many years after banned (1990's)
- Dielectric oils considered non PCB < 50 ppm
  - Fish advisories at 0.05 ppm
- Inadvertent production
  - Carbon + heat + chlorine
  - Up to 50 ppm allowed (TSCA)
- Contaminated sites with active transport (non-point - e.g., CERCLA, RCRA, VRP, unknown)
- Atmosphere (off-gas from contaminated sites)
- Point Sources



# PCB Exposure Pathways (fish)

- Intake through gills from water column (BCF)
  - Basis of existing WQC (1980 EPA guidelines)
- Ingestion of contaminated sediment
  - Indirect uptake from foraging

- Exposure through skin from contaminated sediment (e.g. catfish)
- Ingestion of prey
  - Biomagnification

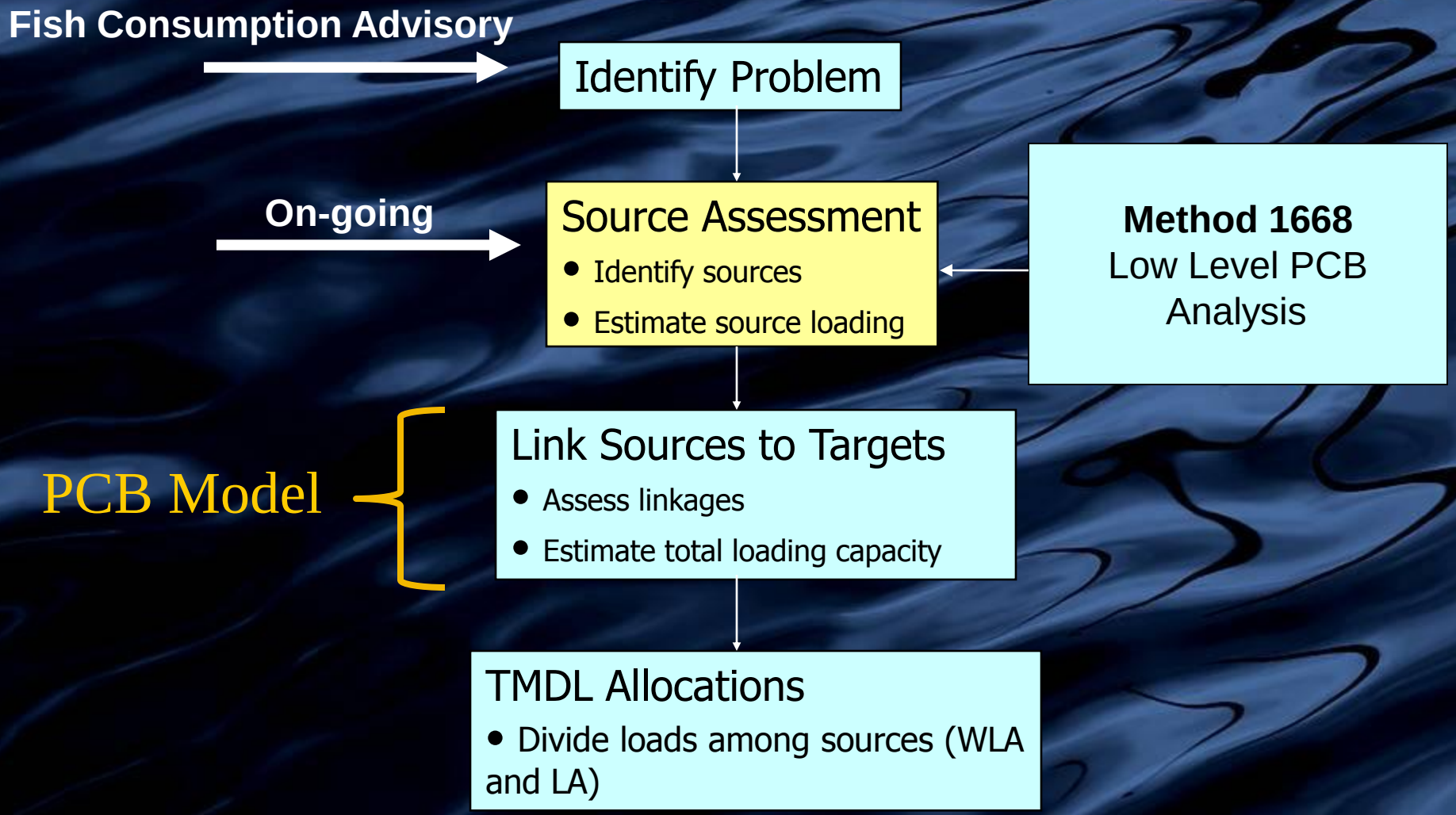
# VA Regulatory Criteria

| Consumption Advisories Fish Tissue (ppb) | | Water Quality Criterion (WQC) Total PCBs (ppb) |
|---|---|---|
| VDH 50 | | |
| DEQ (screening) 20 | ⟷ | 0.00064 |

Criterion represents target concentration in the water column that minimizes the bioaccumulation of tPCBs in fish to protect human consumption

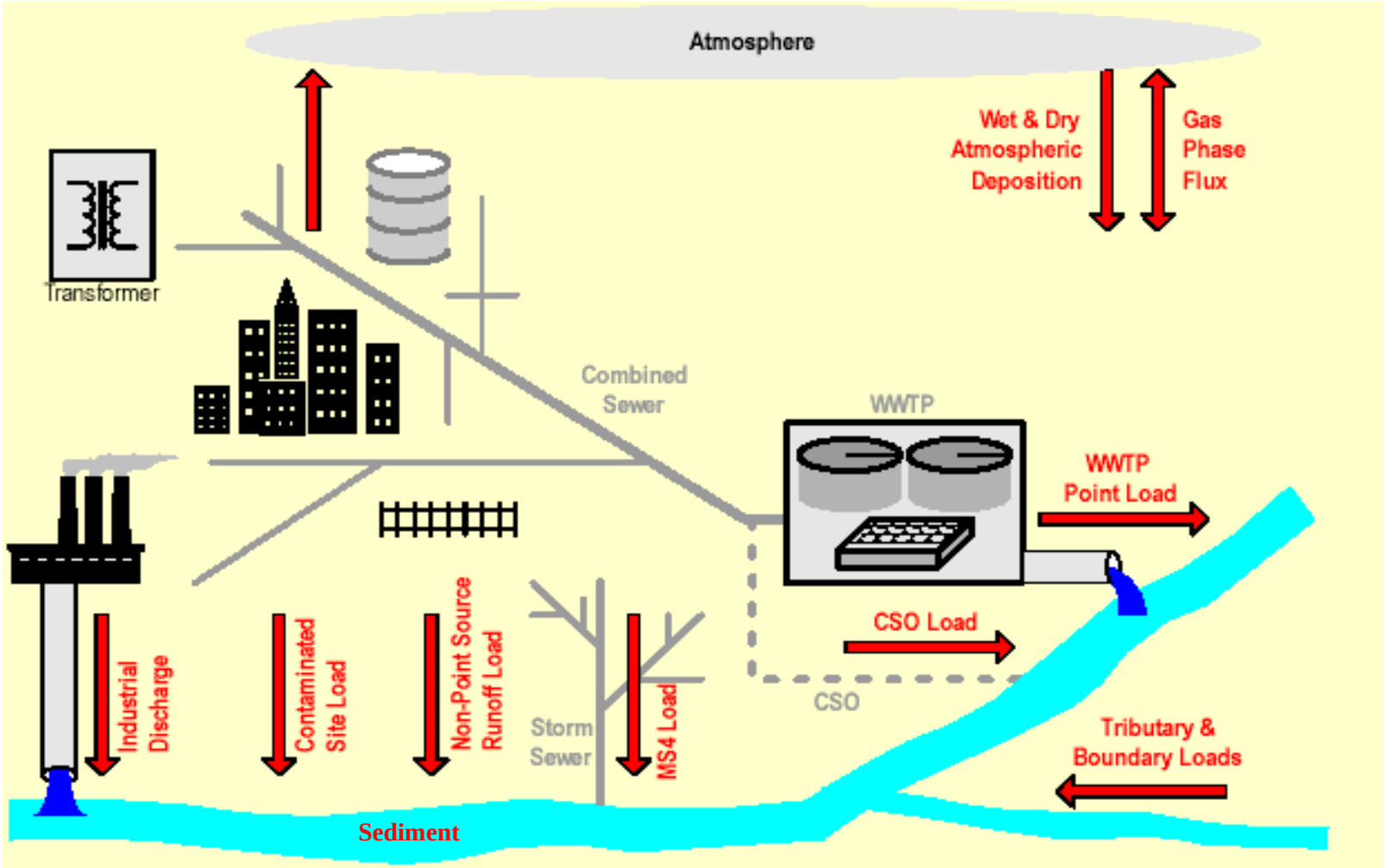
# TMDL Development/Source Assessment

# Components of TMDL Study




**WLA + LA + MOS = TMDL**

# External Sources of PCBs

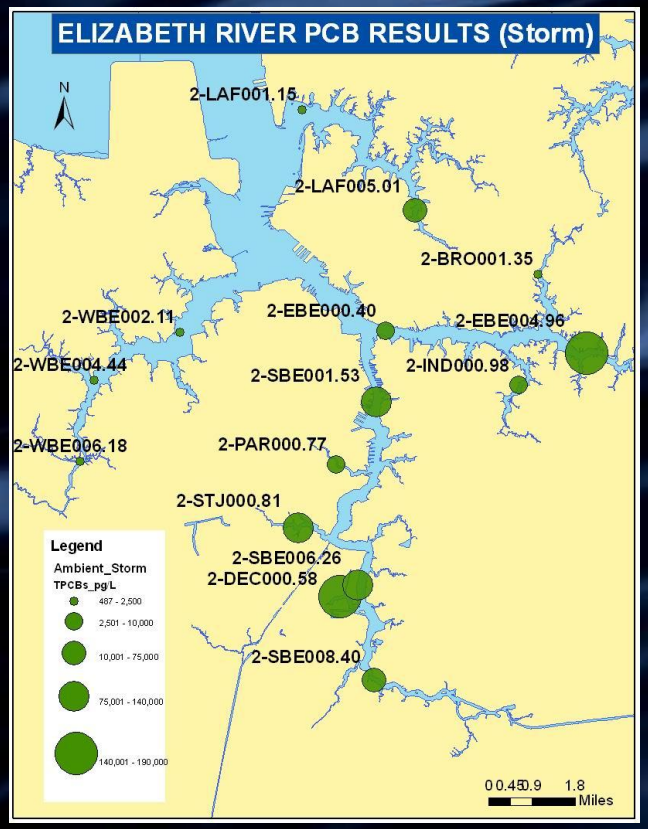


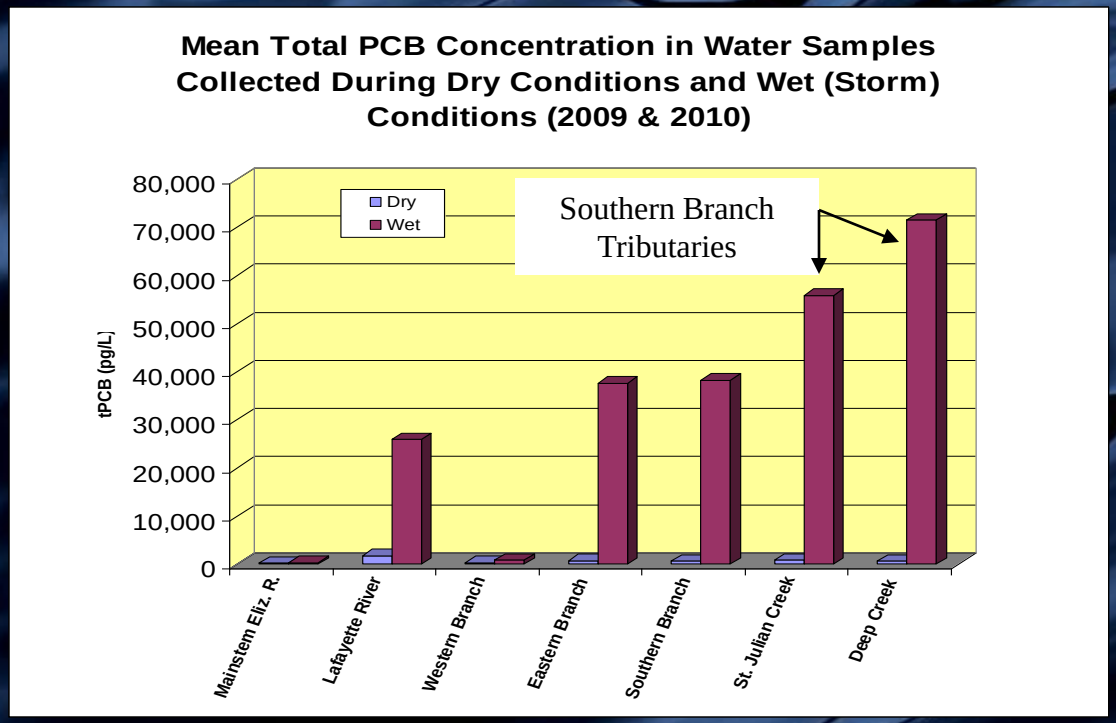

PCB Loading calculated from each category

# TMDL Source Assessment Studies

- Ambient water PCB results necessary to develop TMDLs
  - Source identification
  - Assist in the development of site specific PCB endpoints if appropriate (BAF)
  - Fate & Transport model calibration/validation

# Total PCB Water Results




Water Quality Criterion = 640 pg/L

# Source Assessment
## Atmospheric Deposition

- Literature based PCB values
  - Serve as  default values if other information not available
  - Regional data (Ches. Bay area) from mid ‘90’s or earlier (represent current condition??)
- DEQ designing Air Deposition Study
  - Investigate different landuses
    - Recent studies * show significant gradients (reduction by factor 10) at a distance of 5km

* Du, S.  et al., 2009

# Source Assessment
## Contaminated Sites

- Compile soil data (when available)
  - Remediated site
    - Use clean-up level as PCB concentration
  - Non-remediated site
    - Use median soil concentration
- Apply model
  - Universal Soil Loss Equation (USLE) or similar
  - Derive existing load

# Source Assessment
## Point Sources

- Point Source PCB results necessary for TMDL development
  - Municipal, Industrial, MS4
    - Baseline load development
- EPA Method 608 (Permit method)
  - PCBs rarely detected (MDL = 0.065 µg/L; QL = 0.5 µg/L)
  - Reported as Aroclors
    - Assumes original congener formulation retained

tPCB WQC = 0.00064 µg/L

# Source Assessment
## Point Sources (cont.)

- Develop TMDL Baseline Load
  - No data ≠ no load
  - Use assumptions (Method DL, QL, or ½ of DL, QL as default)
  - Generate low level PCB data
    - Relevant to fish impairments

# Source Assessment
## Point Sources (cont.)

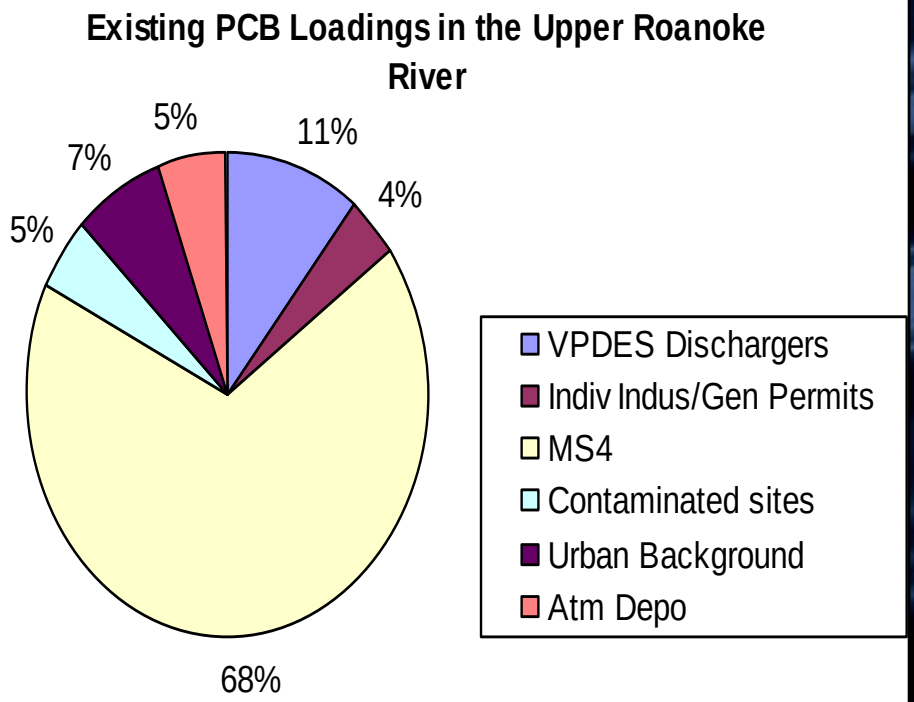
- DEQ requested voluntary monitoring of point source outfalls
  - Informational meetings held:
    - Upper Tidal James - September 2009
    - Elizabeth River – November 2009
    - Middle & Lower Tidal James – October 2010
  - PCB Data requested by Sept. – Oct. 2011
  - Facilities selected in accordance with DEQ's PCB Guidance Document

**http://www.deq.virginia.gov/tmdl/pcb.html**

# Source Assessment
## MS4s

- Preference to develop loads based on actual data (Method 1668)
  - Without data will estimate PCB loads
  - Apply Simple Method for calc. loads (or similar)
    - Landuse considered
- Internal dialogue (DEQ) on how to address PCB contamination
  - Exploring mechanisms to expedite PCB remediation (if/when necessary)

# Upper Roanoke PCB TMDL
## Completed 2009

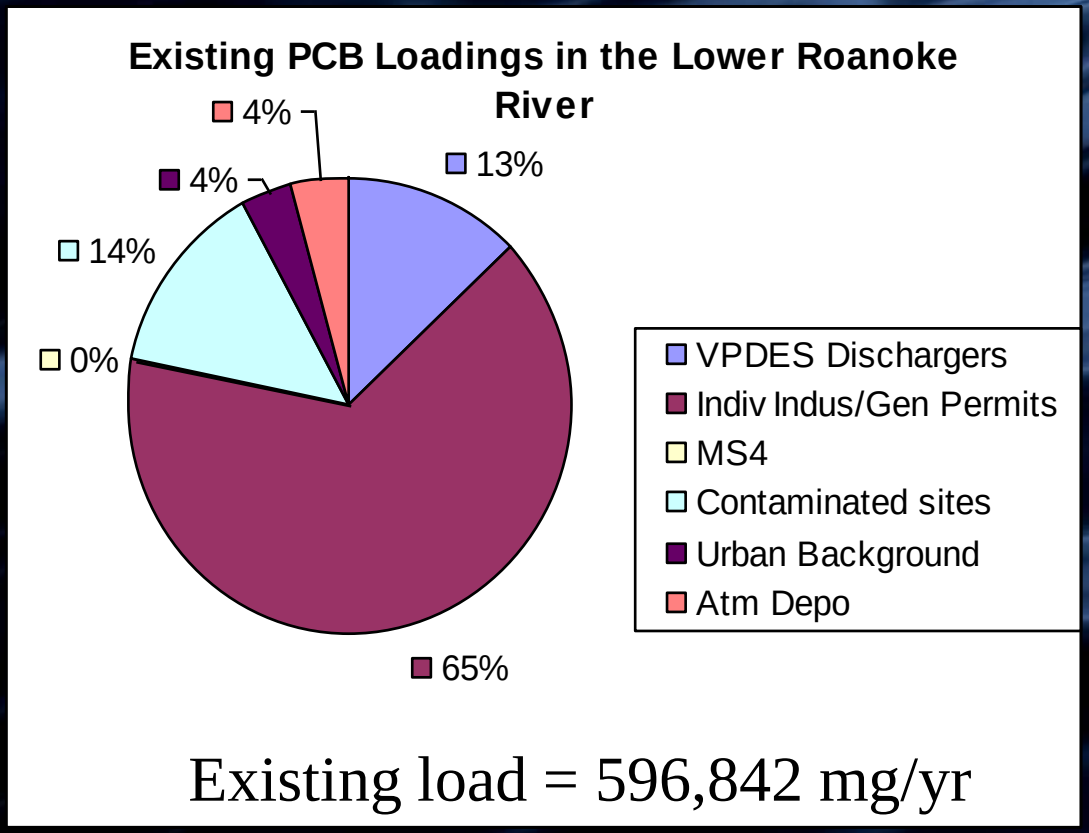



Existing load = 162,914 mg/yr

| Source Category | % Reduction |
|---|---|
| VPDES Dischargers | -60 |
| Indiv Indus/Gen Permits | 99 |
| MS4 | 99 |
| Contaminated sites | 100 |
| Urban Background | 99.4 |
| Atm Depo | 5 |
| total | 77 |

TMDL = 39,094 mg/yr

# Lower Roanoke PCB TMDL
## Completed 2009




Existing load = 596,842 mg/yr

| Source Category | % Reduction |
|---|---|
| VPDES Dischargers | 97.5 |
| Indiv Indus/Gen Permits | 100 |
| MS4 | 99.3 |
| Contaminated sites | 100 |
| Urban Background | 99.4 |
| Atm Depo | 5 |
| total | 95.8 |

TMDL = 26,549 mg/yr

# PCB Analysis

# Investigative PCB Studies

- Historic Focus
  - Fish tissue and sediment sample collection/analysis
  - PCBs detected in water column during 1970's (ug/L)
    - Since 1980's difficult to detect in water matrix (conc. declined)
- Recent Focus
  - PCB data from water matrix (TMDL need)
  - Semi-permeable membrane devices (SPMD lipid bags)
    - Mimic fish (concentrates lipophilic toxins)
  - Improved PCB analytical methods
    - EPA Method 1668 – Detects PCBs in water (ultra-low concentration)
      - Important PCB TMDL development tool

# PCB Analytical Methodology

- EPA Method 1668 (Version A 1999)
  - Current Version 1668C
- High Resolution Gas Chromatography / High Resolution Mass Spectrophotometer (HRGS/HRMS)
- Targets 209 PCB Congeners
  - Summed = tPCB (WQC)
- MDLs < 3 pg/L & QLs 5-20 pg/L on a congener basis
- 2 – 4 L water samples

***PCB congener detection = 0.000003 µg/L***

# EPA PCB Method (1668)

- Analyzes 209 PCB congeners
  - PCB congener profiles deviate from original commercial mixtures (ERASC-003, 2003)
    - Accounts for weathering and biotransformation
  - Can facilitate source identification through "fingerprinting"

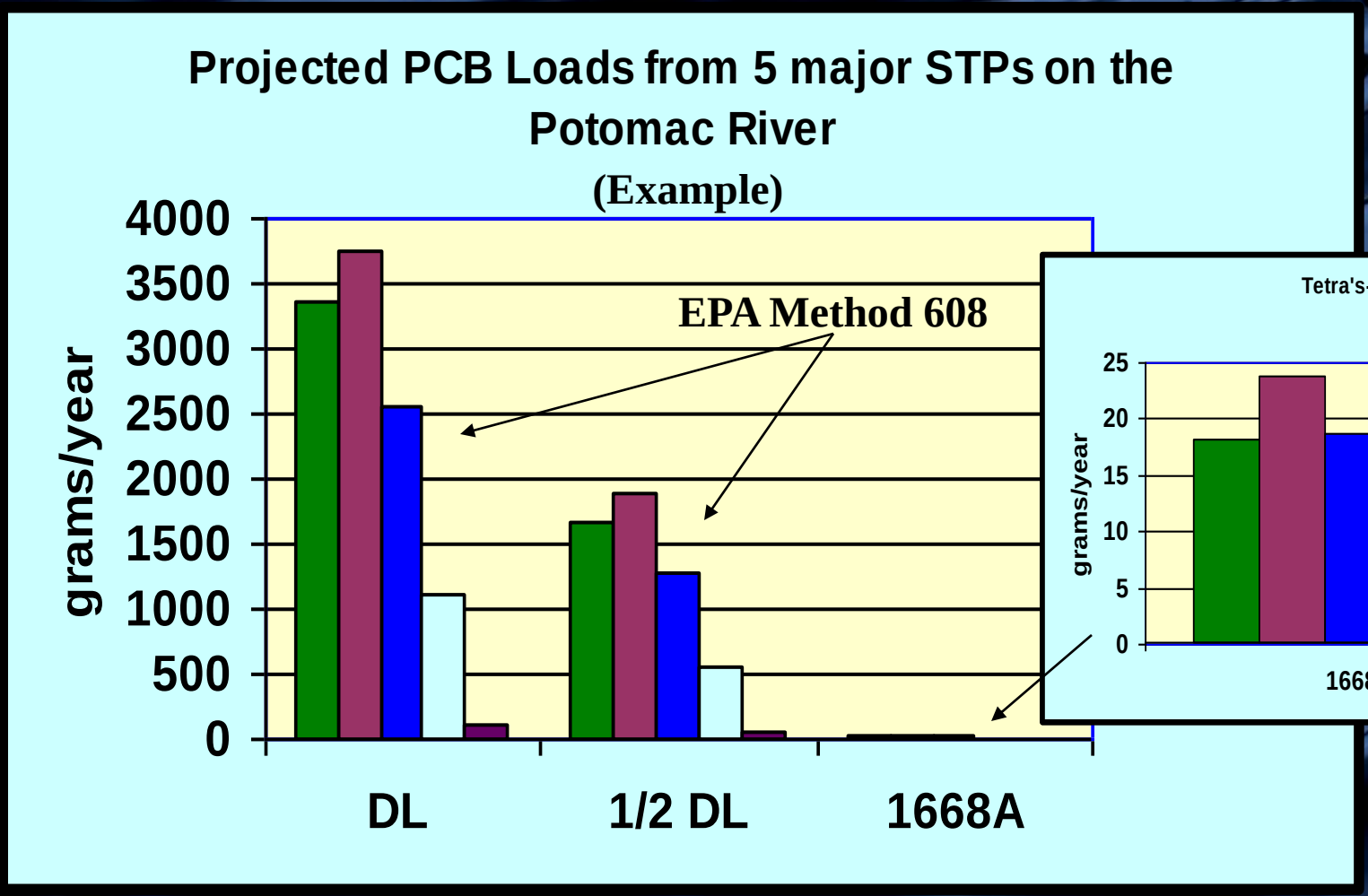
# PCB Analytical Methodology

- Method 1668
  - Memorandum of Support from EPA (June 2007)
    - Contained in TMDL Guidance Memo No. 09-2001 (PCB Point Source Monitoring Guidance)
  - Referenced in EPA's Draft Guidance Document (April 2011)
    - Developing Total Maximum Daily Loads (TMDLs) for Waters imparied by Polychlorinated Biphenyls (PCBs)

# PCB Interlaboratory Study

- Virginia Association of Municipal Wastewater Agencies (VAMWA) and Virginia Manufacturing Association (VMA)
  - Evaluated Method 1668
- DEQ has reviewed study and provided comments
- Responses provided by VAMWA & VMA
  - Currently under review by DEQ

# Assumptions vs. Real Data



# Questions?

**Presentations and Handouts Available at:**
**http://www.deq.virginia.gov/tmdl**

**DEQ PCB Website:**
**http://www.deq.virginia.gov/tmdl/pcb.html**

# Extra Slides

# Point Sources

- TMDL requirements:
  - Baseline or existing load condition
  - Waste Load Allocations (WLAs)

$$\text{Baseline PCB Condition (g/yr)} = \left[\text{PCB conc. ng/L}\right] * \left[\text{Ave Flow (mgd)}\right] * \text{Conv. Factor}$$

$$\text{TMDL WLA (g/yr)} = \left[\text{PCB Endpoint conc. conc. ng/L}\right] * \left[\text{Design Flow (mgd)}\right] * \text{Conv. Factor}$$

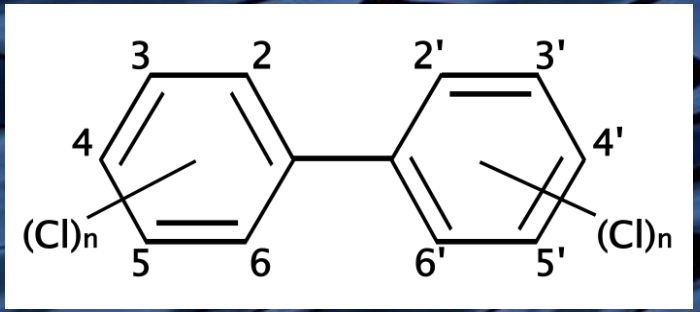
# Potomac River PCB TMDL
## Completed 2007

**Total PCB loads to the tidal Potomac and Anacostia rivers, in g/year**

| Source category | Baseline (g/year) | TMDL (g/year) | Reduction |
|---|---|---|---|
| Potomac @ Chain Bridge[1] | 16,433 | 329 | 98% |
| Lower Basin Tributaries[2] | 2,857 | 407 | 86% |
| Direct drainage[3] | 10,996 | 413 | 96% |
| WWTP[4] | 762 | 68.2 | 91% |
| CSO[5] | 3,020 | 61.2 | 98% |
| Atmospheric deposition[6] | 3,070 | 217 | 93% |
| Contaminated sites[7] | 15.1 | 10.8 | 28% |
| TOTAL[8] | 37,156 | 1,505 | 96% |

# PCB Description and Use

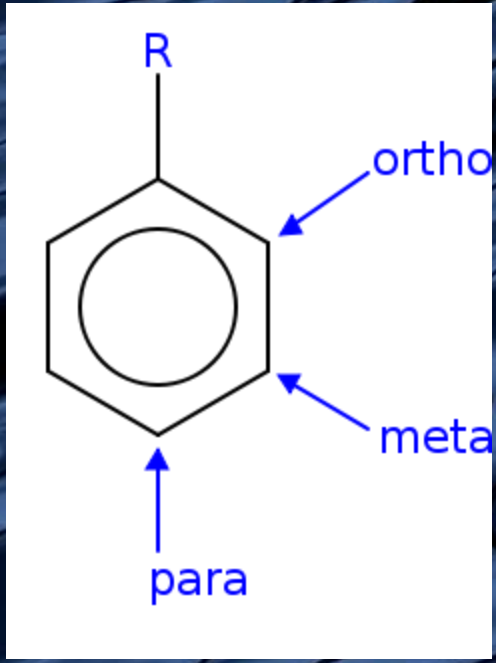
- Biphenyl ring structure with 1 to 10 chlorines
- 209 congeners
- Always present as a mixture
- Mixtures produced under trade name Aroclor (Monsanto)
  - Aroclor 1260
  - 12 – number of carbons
  - 60 – percent chlorine by weight
- Estimated that > 1.5 Billion lbs. manufactured in the U.S.

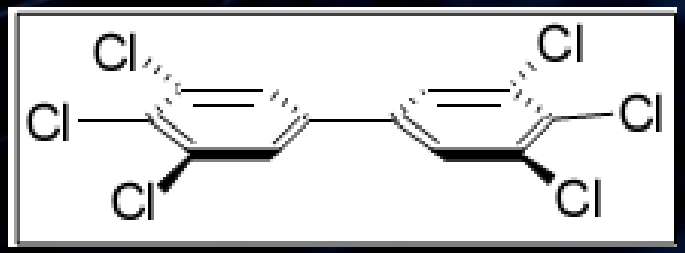



| PCB Homolog | Cl's | Number of Congeners |
|---|---|---|
| Biphenyl | 0 | 1 |
| Monochlorobiphenyl | 1 | 3 |
| Dichlorobiphenyl | 2 | 12 |
| Trichlorobiphenyl | 3 | 24 |
| Tetrachlorobiphenyl | 4 | 42 |
| Pentachlorobiphenyl | 5 | 46 |
| Hexachlorobiphenyl | 6 | 42 |
| Heptachlorobiphenyl | 7 | 24 |
| Octachlorobiphenyl | 8 | 12 |
| Nonachlorobiphenyl | 9 | 3 |
| Decachlorobiphenyl | 10 | 1 |

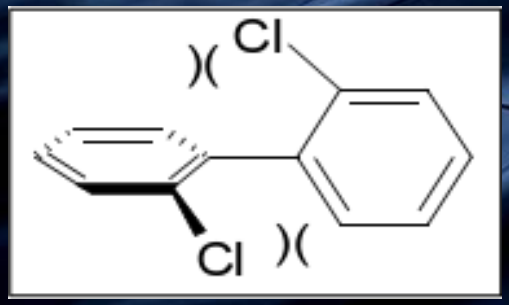
# PCB Description and Use

- Shape of the molecule depends on the location of the chlorine atom
- PCBs without Cl in the ortho position are “coplanar PCBs”
- Coplanar PCBs
  - Resemble dioxin
  - Often more toxic than non-coplanar PCBs




Coplanar PCB




Non-coplanar PCB

# PCB Description and Use

- World Health Organization (WHO)
  - Identified the 12 most toxic or "dioxin-like" PCB Congeners
    - PCB 126 & 169 ~ 100X less toxic than dioxin (TEF 0.01)
- Regulated by VADEQ as Total PCB (tPCB) = Sum 209 Congeners
  - Adhere to EPA guidelines

| PCB | Most Toxic |
|---|---|
| 77 | |
| 81 | |
| 105 | |
| 114 | |
| 118 | |
| 123 | |
| 126 | X |
| 156 | |
| 157 | |
| 167 | |
| 169 | X |
| 189 | |